

REMARKS

By this amendment, applicants have amended the claims to more clearly define their invention. In particular, claim 1 has been amended to recite that the cobalt silicide film is a nickel or iron containing cobalt silicide film and that the ratio of nickel or iron to cobalt in the nickel or iron containing cobalt silicide film is 0.05 to 50 atomic %. See, e.g., page 7, line 24, page 8, line 7 of Applicant's specification.

Claim 3 has been amended to clarify that the cobalt silicide film formed on at least the gate electrode or the diffusion layer(s) is a nickel or iron containing cobalt silicide film and to recite that the principal surface of the silicon substrate is in an Si (111) plane. See, e.g., page 15, lines 8-14 of Applicant's specification. Claim 2 has been amended and claim 5 added to recite that the ratio of nickel or iron to cobalt in the nickel or iron containing cobalt silicide film is 0.05 to 18 atomic %. See, e.g., page 8, lines 8-16 of Applicant's specification. Claims 6 to 9 have been added to further define Applicants' invention, i.e., to recite that the nickel or iron is present in the nickel or iron containing cobalt silicide film in the form of nickel or iron silicide or as single bodies of nickel or iron. See, page 8, lines 17-21 and page 12, lines 8-12 of Applicant's specification.

Claim 1 stand rejected under 35 U.S.C. 102(e) as allegedly being anticipated by U.S. Patent 5,915,197 to Yamanaka et al. Claim 2 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Yamanaka et al. Applicants traverse these rejections and request reconsideration thereof.

Claims 1 and 2 are directed to a semiconductor device in which a nickel or iron containing cobalt silicide film is formed on a silicon substrate. The principal surface of the silicon substrate which is in contact with a cobalt silicide film is an Si (111) plane, while the principal surface of the cobalt silicide film which is contact with

the Si (111) plane is in a CoOSi₂ (111) plane. The ratio of nickel or iron to cobalt in the cobalt silicon film is 0.05 to 50 atomic %, preferably 0.05 to 18 %. Such is neither disclosed nor suggested by Yamanaka et al.

The patent to Yamanaka et al. discloses a fabrication process for a semiconductor device and discloses that, when the surface is a silicon (111) surface, the interface energy between the refractory silicide layer and the silicon becomes more stable in comparison with the case where the surface of the silicon is formed by other surfaces, and thus deformation of plane can be easily prevented. However, as admitted by the Examiner, the Yamanaka et al. patent does not disclose the use of a nickel or iron containing cobalt silicide film in which the ratio of nickel or iron to cobalt in the cobalt silicide film is 0.05 to 50 atomic %. While the Examiner alleges that it would have been obvious to determine the optimum condition of the layers, the Examiner has not shown any teaching or suggestion in the prior art to do so. The general allegation made by the Examiner is not the type of specific evidence necessary to support an obviousness rejection. Absent a teaching in the prior art to use a nickel or iron containing cobalt silicide film in which the ratio of nickel or iron to cobalt is 0.05 to 50 atomic %, the Examiner's reasoning amounts to no more than hindsight reconstruction of the prior art based on the teachings in Applicant's specification.

In any event, the use of a nickel or iron containing cobalt silicide film in which the ratio of nickel or iron to cobalt is 0.05 to 50 atomic % provides unexpectedly advantageous results as demonstrated in the subject application. Referring to Figure 16 and the disclosure in the paragraph bridging pages 7 and 8 of Applicant's specification, it can be seen that, when the adding element concentration is about 0.05 atomic % or more based on Co in the cobalt silicide film, the grain boundary

diffusion coefficient decreases sharply to inhibit diffusion. Moreover, as explained at page 8, lines 4-7 of Applicant's specification, when the adding element is added in an amount of 50% or more, it is not possible for cobalt silicide to exist as such. Therefore, the ratio of the adding element in cobalt in the cobalt silicide film is preferably 0.05 to 50 atomic %. Such is neither disclosed nor suggested by Yamanaka et al.

Moreover, with respect to claim 2, Figure 17 and the description at page 8, lines 8-16 demonstrate the unexpectedly advantageous results of the ratio of the adding element to cobalt being in the range of 0.05 to 18 atomic %. That is, as is seen from Figure 17, when the adding element concentration becomes more than about 18% based on Co in the cobalt silicide film, the grain boundary diffusion coefficient increases to reduce the diffusion inhibitory effect. Thus, the ratio of the adding element to Co in the cobalt silicide film is more preferably 0.05 to 18 atomic %. Such is neither disclosed nor suggested by Yamanaka et al. Accordingly, claim 2 is patentable over Yamanaka for this additional reason.

Claim 3 stands rejected under 35 U.S.C. 102(e) as allegedly being anticipated by the Mo et al. article. Claim 4 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Mo et al. Applicants traverse these rejections and request reconsideration thereof.

The Mo et al. article discloses studies on the ternary silicide $(Co_xNi_{1-x})Si_2$ formed by NiCo thin films or Ni, Co and Ti thin films deposited on Si (100) substrates. However, claims 3 and 4 now recite that the principal surface of the silicide substrate is an Si (111) plane. Clearly the Mo et al. article does not disclose and would not have suggested the presently claimed process including the principal surface of the silicon substrate being in an Si (111) plane.

Moreover, with respect to claim 4, it is submitted that the Mo et al. article would not have suggested the unexpectedly advantageous results achieved by controlling the concentration of nickel or iron in the nickel or iron containing cobalt silicide film to 0.05 to 50 atomic % based on cobalt or, with respect to claim 5, to 0.05 to 18 atomic % based on cobalt. Accordingly, claims 3-5 are neither disclosed nor suggested by Mo et al.

Newly added claims 6-9 are patentable over Yamanaka et al. and Mo et al. for the reasons noted above.

In view of the foregoing amendments and remarks, favorable reconsideration and allowance of all of the claims now in the application are requested.

To the extent necessary, applicants petition for an extension of time under 37 CFR 1.136. Please charge any shortage in the fees due in connection with the filing of this paper, including extension of time fees, to the deposit account of Antonelli, Terry, Stout & Kraus, LLP, Deposit Account No. 01-2135 (Case: 500.39907VX1), and please credit any excess fees to such deposit account.

Respectfully submitted,

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